

GENERAL NOTES

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A REVIEW OF THE STATUS OF *EUREMA DAIRA PALMIRA* (POEY) (PIERIDAE) IN FLORIDA, INCLUDING ADDITIONAL RECORDS FROM THE LOWER FLORIDA KEYS

Additional key words: *Eurema daira daira*, West Indies, subspecies.

The "barred" group of New World taxa within the genus *Eurema* Hübner has long confounded researchers. Similarities between species and confusion concerning the status of seasonal polyphenisms have led to misconceptions of species biology and distribution (Klots, A. B. 1928, *J. N.Y. Entomol. Soc.* 36:61-78; Klots, A. B. 1929, *Entomol. Amer.* 9: 99-171; Brown, F. M. & B. Heineman 1972, Jamaica and its butterflies, E. W. Classey, Ltd., London, 478 pp.). Most males of this group are bicolored, possessing a dorsal ground color of yellow (forewings) and white (hindwings). Females are predominantly white. An exception to this rule is the widespread North American *Eurema daira daira* (Godart) which is usually unicolored (yellow) in both sexes.

The bicolored Neotropical subspecies, *Eurema daira palmira* (Poey 1853), occurs throughout much of the West Indies, including Cuba (the type locality) and the Bahamas, where it is apparently rare (Riley, N. D. 1975, *A field guide to the butterflies of the West Indies*, Demeter Press, Boston, Massachusetts, 224 pp.; Leston, D. & D. S. Smith 1980, *Florida Entomol.* 63:509-510). Since the mid-nineteenth century, this taxon has been attributed to Florida and Georgia (Morris, J. G. 1862, *Smiths. Misc. Coll.*, Washington, D.C., 358 pp.; Weidemeyer, J. W. 1863-64, *Proc. Entomol. Soc. Phil.* 2:143-154, 513-542; Edwards, W. H. 1872, *Synopsis of North American butterflies*, Amer. Entomol. Soc., Philadelphia, Pennsylvania, 52 pp.). Although W. H. Edwards (1877, *Trans. Amer. Entomol. Soc.* 6:1-68) dismissed the occurrence of *E. d. palmira* in North America, authors continued to associate North American butterflies with this taxon (Röber, J. 1907, *Family Pieridae*, pp. 53-111 in A. Seitz (ed.), *Macrolepidoptera of the world*, Vol. 5, A. Kernan, Stuttgart; Wood, W. C. 1939, *Entomol. News* 50:131; Klots, A. B. 1948, *Lepid. News* 2: 51-53; Klots, A. B. 1951, *A field guide to the butterflies of North America*, east of the Great Plains, Houghton Mifflin Co., Boston, Massachusetts, 349 pp.; Young, F. N. 1955, *Lepid. News* 9:204-212; Ehrlich, P. R. & A. H. Ehrlich 1961, *How to know the butterflies*, W. C. Brown Co., Dubuque, Iowa; Kimball, C. P. 1965, *Lepidoptera of Florida*, Div. of Plant Industry, Gainesville, Florida, 363 pp.).

H. K. Clench (1970, *J. Lepid. Soc.* 24:240-244) subsequently reported the capture in southern Florida of several *E. d. palmira*, together with *E. d. daira*, and discussed facies differences between the two subspecies based on Cuban and Floridian material. He noted that males of *E. d. daira* in southern Florida occasionally possess white dorsal hindwings, but they should not be confused with *E. d. palmira*. Nevertheless, the status of bicolored *E. daira* in Florida remained uncertain and misunderstood and authors persisted in referring all bicolored individuals to *E. d. palmira* (e.g., Howe, W. H. 1975, *The butterflies of North America*, Doubleday & Co., Inc., Garden City, New York, 633 pp.; Brewer, J. 1982, *A butterfly watchers guide to the butterflies of Sanibel and Captiva*, Sanibel-Captiva Conservation Foundation, Sanibel Island, Florida, 41 pp.). L. D. Miller and F. M. Brown (1981, *Lepid. Soc. Memoir No. 2*:1-280) unintentionally contributed to the confusion by mistakenly synonymizing *E. d. daira* fm. 'delioides' Haskin (type locality, Auburndale, Florida) under *E. d. palmira*, an error perpetrated earlier by C. F. dos Passos (1964, *Lepid. Soc. Memoir No. 1*:1-145). Miller and Brown (*op. cit.*) ultimately cast doubt on the validity of *E. d. palmira* in North America and tentatively listed the subspecies pending additional research.

To help clarify the status of bicolored *E. daira* in Florida, D. S. Smith et al. (Smith, D. S., D. Leston & B. Lenczewski 1982, *Bull. Allyn Museum* 70:1-8) collected a large

series of this species from a variety of locations in southern Florida. They concluded that males of *E. d. daira* show a balanced polymorphism for dorsal hindwing ground color and most, if not all, reports of Floridian *E. d. palmira* are referable to *E. d. daira*. Smith et al. further concluded that Cuban *E. d. palmira* may occasionally reach Florida, but that evidence of their establishment is lacking. These findings have been misconstrued (e.g., Schwartz, A. 1987, Milwaukee Public Museum Contrib. in Biol. & Geol. 73:1-34) as testimony to the total absence of *E. d. palmira* in southern Florida. Although Smith et al. (*op. cit.*) did not reject the occurrence of *E. d. palmira* in Florida, they were clearly unaware of valid records and did not attempt to verify published reports of this subspecies.

More recently, P. A. Opler and G. O. Krizek (1984, Butterflies east of the Great Plains, Johns Hopkins Univ. Press, Baltimore, Maryland, 294 pp.) defined bicolored individuals of *E. daira* from southern Florida as indicating "genetic influx from the Antilles" without reference to *E. d. palmira*. Conversely, J. A. Scott (1986, The butterflies of North America, Stanford Univ. Press, Stanford, California, 583 pp.) and C. D. Ferris (1989, Lepid. Soc. Memoir No. 3:1-103) recognized the occurrence of *E. d. palmira* in North America. M. C. Minno and T. C. Emmel (1988, 39th Ann. Mtg. of the Lepid. Soc. Abstracts, p. 13) reported the capture of females of *E. d. palmira* on Big Pine Key (Monroe Co.), Florida. Four previously unreported bicolored specimens provide further evidence of the occurrence of *E. d. palmira* in southern Florida.

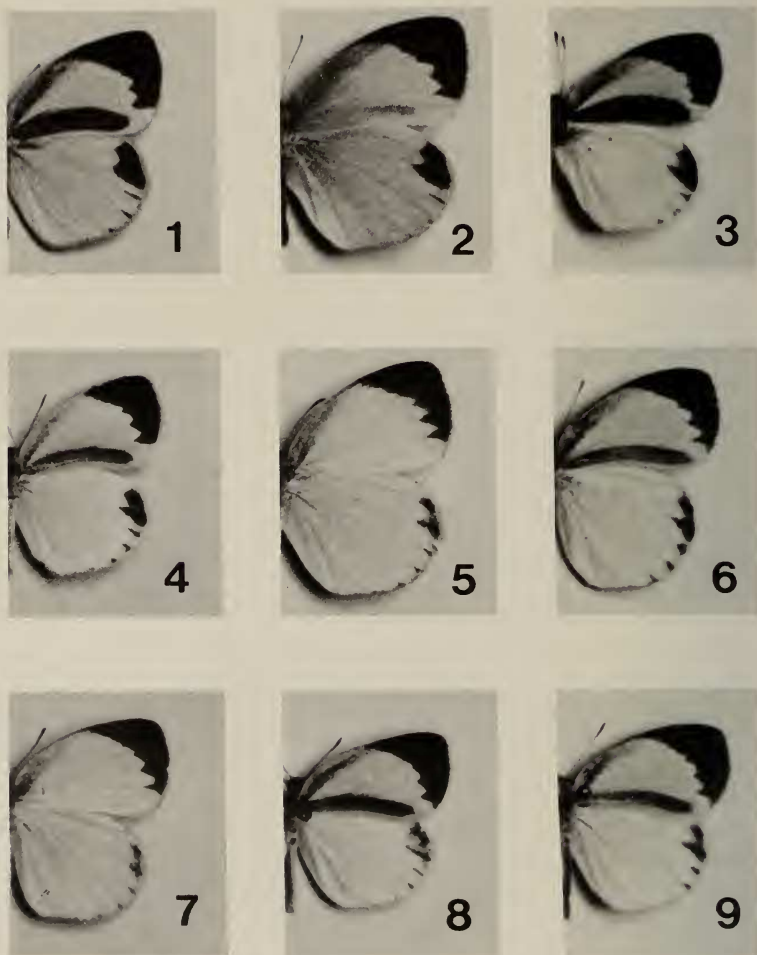
On 26 November 1972, the junior author collected one bicolored *E. daira* on Sugarloaf Key, Monroe Co., Florida and three additional males 20-28 December 1972 on Key West, Monroe Co., Florida. These specimens (Figs. 8, 9) are in good condition and morphologically consistent with *E. d. palmira* fm. 'ebriola' (Figs. 4, 5). The three individuals from Key West were visiting flowers of *Bidens alba* (L.) DC. (= *pilosa* L.) (Asteraceae) in an open, weedy vacant lot. Several others of this phenotype were seen but not collected. Typical *E. d. daira* were also present at this location. No additional information is available for the single individual from Sugarloaf Key.

The 1972 captures in the Lower Florida Keys prompted us to re-examine the Floridian specimens purported by Clench (*op. cit.*) to be *E. d. palmira*. These specimens (four males, four females), collected 22 and 31 December 1967 from two sites at Chokoloskee, Monroe Co., Florida, are also morphologically consistent with *E. d. palmira* fm. 'ebriola'. Despite an abundance of typical *E. d. daira*, Clench noted a lack of what he believed would represent "intermediates" among the adults he observed. The specimens (Figs. 6, 7) are generally in good condition.

It is our belief that additional Floridian *E. d. palmira* are harbored in collections among specimens of the nominate subspecies. These subspecies are superficially very similar and their identification is complicated by great seasonal and individual variation. The following comparisons (based on material from Florida, Cuba and Jamaica) are intended to illustrate morphological trends useful in discriminating these taxa in Florida. For convenience, these subspecies are defined in terms of "wet-season" and "dry-season" forms. These forms represent extremes; intermediates are common. The most conspicuous facies character of male *E. d. palmira* is the relatively narrow gray posterior forewing bar that is often subtended by a prominent orange inner margin. In both dry- and wet-season forms of *E. d. daira*, the forewing bar is wide, broadly reaching the discal cell and vein CU_2 and the orange inner margin is narrow and indistinct. The bar of *E. d. palmira* may possess much basal white scaling. In 'ebriola', these scales can be very numerous, occasionally obliterating the basal portion of the bar. This basal scaling is usually minimal and more yellow when present in *E. d. daira*.

The dorsal hindwing ground color of male *E. d. palmira* is white, whereas that of male *E. d. daira* varies continuously from yellow to white (see Smith et al., *op. cit.*). The dorsal ground color of female *E. d. palmira* is white and frequently has a yellow flush on the costal and apical regions of the forewing and apical region of the hindwing. The dorsal ground color of female *E. d. daira* is highly variable, ranging from nearly white to yellow. Although some females of *E. d. daira* may be very pale (reminiscent of *E. d. palmira*), they often possess much gray scaling, particularly those of the wet-season form 'jucunda' (Boisduval & LeConte) which frequently bear a distinct posterior forewing bar.

The dorsal hindwing apical black patch of both sexes of dry-season *E. d. palmira* is



FIGS. 1-9. *Eurema daira*: 1, 2, *E. d. daira* fm. 'daira'; 4-9, *E. d. palmira* fm. 'ebriola'. 1, Male, 7 Oct. 1973, Key West, Florida (R. Anderson); 2, Female, 9 Jan. 1986, Lee Co., Florida (J. Calhoun); 3, Male, bicolored original specimen for Holland Plate XXXVII, fig. 12; 4, Male, 24 Nov. 1929, Sierra Maestra East, Cuba (O. Querci); 5, Female, 16 Feb. 1930, Sierra Maestra East, Cuba (O. Querci); 6, Male, 31 Dec. 1967, Chokoloskee, Florida (H. & M. Clench); 7, Female, 31 Dec. 1967, Chokoloskee, Florida (H. & M. Clench); 8, Male, 26 Nov. 1972, Sugarloaf Key, Florida (R. Anderson); 9, Male, 28 Dec. 1972, Key West, Florida (R. Anderson).

more poorly developed than in dry-season *E. d. daira* form 'daira' (Godart) (Figs. 1, 2). The black patch of *E. d. palmira* is often reduced to a series of vague marginal spots, the largest being two triangular spots at the end of veins Rs and M₁. The apical black patch of dry-season *E. d. daira* is typically prominent; dark spots at the ends of veins Rs and M₁ are fused, forming one large and distinctive pattern element. A series of additional marginal spots may be obvious or virtually absent. Males of wet-season *E. d. palmira* form 'palmira' (Poey) possess a dorsal hindwing black border that tapers toward the anal

angle and has a fairly well defined and scalloped inner margin. Wet-season females have a black border that is similar to the male or reduced and only slightly more developed than in the dry-season form. The size and clarity of this black border is variable in both sexes of wet-season *E. d. daira*, ranging from a configuration similar to that of *E. d. palmira*, to a wide, poorly defined and less tapering band that becomes more diffuse toward the inner margin. Wet-season males of the two subspecies can be difficult to distinguish; the width of the posterior forewing bar can be a decisive character.

The fact that *E. d. daira* regularly produces bicolored phenotypes in Florida provides insight into the status of an old and controversial bicolored male specimen figured by W. J. Holland (1898, *The butterfly book*, Doubleday, Page & Co., New York, New York, 382 pp.: Plate XXXVII, fig. 12). Holland identified the specimen as *Eurema elathea* (Poey), a Neotropical species often confused with *E. d. palmira* and not reliably recorded in North America. Holland (1915, *The butterfly guide*, Doubleday, Page & Co., Garden City, New York, 237 pp.) alluded to a Floridian origin of this specimen by again figuring it (Plate CIX, fig. 2) and employing the common name "the Florida yellow" in his corresponding text discussion. Klots (1948, 1951, *op. cit.*) argued that the specimen is actually a misidentified *E. d. palmira* fm. 'ebriola' (Poey) and doubted a North American origin, retorting "apparently, Holland not only had a specimen with inaccurate data but also figured it under the wrong name". It is obvious that Klots never saw the original specimen. The senior author examined this specimen (in the Carnegie Mus. Nat. Hist.) (Fig. 3) and found it to lack locality data. Rather, it has a crude pencilled label reading "elathea" in Holland's handwriting and another small and very old label bearing only the handwritten number "6", possibly affixed by the collector in reference to a personal journal notation. The specimen (now without an abdomen) resembles Mexican and Central American populations of the *E. daira* complex, but the lack of data and phenotypic similarity to a bicolored dry-season *E. d. daira* do not rule out a Floridian origin.

Although all the specimens of Floridian *E. d. palmira* we examined are of the dry-season form, a specimen figured by Howe (*op. cit.*: Plate 72, fig. 14) presents a male, collected 22 October 1965 at Coral Gables (Dade Co.), Florida, that exhibits facies characteristics of the wet-season form. These records raise questions regarding the apparent sympatric occurrence of two subspecies of *E. daira* in southern Florida.

Although Clench and the junior author encountered a number of relatively unworn *E. d. palmira* at four separate locations, there is no evidence to suggest that a sympatric population of this taxon is, or ever was, established in Florida. This is true despite the misleading comment by Klots (1951, *op. cit.*) proposing that *E. d. palmira* in Florida is a "comparatively recent introduction" which "may die out". The long-term sympatric occurrence of two subspecies is, of course, improbable.

The presence of *E. d. palmira* in Florida is likely the result of emigrations from the West Indies, especially Cuba. This subspecies is an effective vagrant throughout its range (L. D. Miller pers. comm.) and Brown and Heineman (*op. cit.*) suspected that this is the reason that no island strains have developed distinctive forms in the Greater Antilles. In addition, a Central American member of the *E. daira* complex has been observed participating in at least one mass migration (Williams, C. B. 1930, *The migration of butterflies*, Oliver & Boyd, Edinburgh, Scotland, 473 pp.). Gravid immigrant females or immigrant pairs that manage to locate one another may produce offspring in Florida, conceivably accounting for the good condition of the specimens we examined. During the early 1970's, West Indian species of Pieridae, Lycaenidae and Nymphalidae were collected in southern Florida (Anderson, R. A. 1973, *J. Lepid. Soc.* 28:354-358; Fisher, M. S. 1973, *J. Lepid. Soc.* 28:305; Bennett, R. & E. C. Knudson 1976, *J. Lepid. Soc.* 30:234-235). The factors responsible for the immigration of these species into southern Florida (e.g., tropical storms, density-dependent emigration) also may have been responsible for the occurrence of *E. d. palmira* on Key West and Sugarloaf Key in 1972. Bicolored individuals of *E. d. daira* in southern Florida may be due to the introgression of alleles from *E. d. palmira* (Minno & Emmel, *op. cit.*), thus such immigrations may be frequent but overlooked.

Clench (*op. cit.*) discussed the controversial possibility that *E. d. palmira* and *E. d. daira* are two separate species. To a limited extent, this concept was previously endorsed (albeit hesitantly) by Klots (1938, 1939, *op. cit.*). Clench based this conclusion on the

many phenotypic differences between these subspecies and the absence of "intermediates" among the specimens he collected at Chokoloskee. If this hypothesis is correct, *E. d. palmira* could be a rarely encountered (or overlooked) resident species in Florida or an irregular immigrant capable of establishing temporary breeding populations. Clench's failure to find additional *E. d. palmira* at Chokoloskee, two years after his initial visit, may be indicative of temporary residency.

A lack of "intermediates" does not necessarily imply that *E. d. palmira* is worthy of species-level status. If the *E. d. palmira* phenotype is recessive to that of *E. d. daira*, and differences between the subspecies are the result of a single genetic locus under simple dominant-recessive allelic expression, hybrids would possess facies characteristics of the nominate subspecies and recessive phenotypes would resemble *E. d. palmira*. In this genetic scenario, the "many intermediates" discussed and figured by Howe (*op. cit.*) would not be expected to occur. Smith et al. (*op. cit.*) dismissed such "intermediates" as within the range of variation of *E. d. daira*. The recessiveness or genetic swamping (or both) of the *E. d. palmira* phenotype also offer alternative explanations for the temporary occurrence of this taxon at Chokoloskee (Clench, *op. cit.*). The conventional subspecific status of *E. d. palmira* would be challenged by the discovery of a sympatric population of this taxon that is capable of retaining its genetic integrity in the presence of *E. d. daira*.

Finally, one should not preclude the possibility that supposed Floridian *E. d. palmira* are simply extreme examples of *E. d. daira*. This notion is perhaps supported by the paucity of known records. However, records consisting of more than one butterfly resembling *E. d. palmira*, especially males and females collected simultaneously within a limited area, suggest more than mere individual variation.

Bicolored males and pale females of *E. daira* encountered in southern Florida should be closely examined. Detailed electrophoretic experiments, breeding, and field studies would help resolve the enduring problematic ecological and taxonomic status of Floridian *Eurema daira palmira*.

The Florida Keys specimens of *E. d. palmira* are deposited in the collections of the authors and The Allyn Museum of Entomology, Florida Museum of Natural History. Thanks are extended to L. D. Miller and T. W. Turner for their opinions regarding the identity of the Florida Keys specimens, and to T. W. Turner, S. J. Ramos and an anonymous reviewer for helpful comments on the manuscript. We also wish to thank J. E. Rawlins of the Carnegie Museum of Natural History for the loan of specimens.

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THE CAPTURE AND RELEASE OF A MONARCH BUTTERFLY (NYMPHALIDAE: DANAINAE) BY A BARN SWALLOW

Additional key words: aposematic, predation, Pennsylvania.

The monarch butterfly, *Danaus plexippus* (Linnaeus) (Nymphalidae: Danainae) is among the best studied of aposematic insects. The monarch's bright orange and black coloration warns predators of its cardenolide chemical defense (Brower, L. P. 1969, *Sci. Am.* 220:22-29; Brower, L. P. & S. C. Glazier 1975, *Science* 188:19-25). Although a few predators are able to circumvent the monarch's chemical defense (Brower, L. P. & W. H. Calvert 1985, *Evolution* 39:852-868; Calvert, W. H., L. E. Hedrick & L. P. Brower